

Response Under 37 C.F.R. 1.116

Applicant: Hong-Jyh Li et al.

Serial No.: 10/799,910

Filed: March 12, 2004

Docket No.: 2004P50029US/I331.135.101

Title: ION IMPLANTATION OF HIGH-K MATERIALS IN SEMICONDUCTOR DEVICES

IN THE CLAIMS

1. (Previously Presented) A semiconductor device comprising:
a substrate including isolation regions and active regions;
a high-k material layer implanted with a species, the high-k material layer proximate the substrate;
a gate electrode proximate the high-k material layer; and
a conductive buffer layer implanted with a species between the high-k material layer and the gate electrode.
2. (Original) The semiconductor device of claim 1, wherein a transistor is formed from the substrate, the high-k material layer, and the gate electrode.
3. (Original) The semiconductor device of claim 1, further comprising:
a pre-gate material layer between the substrate and the high-k material layer.
4. (Original) The semiconductor device of claim 3, wherein the pre-gate material layer comprises one of SiO₂ and SiON.
5. (Original) The semiconductor device of claim 3, wherein the pre-gate material layer has a thickness within the range of 2Å to 10Å.
6. (Cancelled)
7. (Previously Presented) The semiconductor device of claim 1, wherein the buffer layer comprises one of TiN, HfN, TaN, ZrN, LaN, and TiSi.

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8. (Previously Presented) The semiconductor device of claim 1, wherein the buffer layer has a thickness within the range of 10Å to 200Å.
9. (Original) The semiconductor device of claim 1, wherein the species comprises one of N, F, Si, O, Hf, Zr, Ti, Ta, Y, V, Sc, Ba, Sr, Ru, B, Al, Ga, In, Ge, C, P, As, and Sb.
10. (Original) The semiconductor device of claim 1, wherein the high-k material layer comprises one of HfO₂, HfSiO_x, ZrO₂, ZrSiO_x, SiO₂, SiON, Ta₂O₅, La₂O₃, and Al₂O₃.
11. (Original) The semiconductor device of claim 1, wherein the high-k material layer has a thickness within the range of 10Å to 60Å.
12. (Original) The semiconductor device of claim 1, wherein the high-k material layer has an equivalent oxide thickness within the range of 3Å to 20Å.
13. (Original) The semiconductor device of claim 1, wherein a dose of the implanted species is within the range of 1x10¹³ ions/cm² to 1x10¹⁶ ions/cm².
14. (Original) The semiconductor device of claim 1, wherein the isolation regions comprise trench isolation regions.
15. (Previously Presented) A transistor comprising:
 - a gate electrode;
 - a high-k gate dielectric layer implanted with a species, the high-k gate dielectric layer proximate the gate electrode;
 - a substrate comprising an active region, the substrate proximate the high-k gate dielectric layer; and

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a conductive buffer layer implanted with a species between the gate electrode and the high-k gate dielectric layer.

16. (Cancelled)

17. (Original) The transistor of claim 15, wherein the gate electrode comprises one of aluminum and polysilicon.

18-40. (Cancelled)